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PENSOFT

First record of Sooty Tern, *Onychoprion fuscatus* (Linnaeus, 1766) (Laridae, Charadriiformes), from São Paulo state, Brazil

Juarez de Castro Cabral[1*], Vanessa Lanes Ribeiro[1], Gabriela Cristina da Silva[1], Isabella Cristina da Rocha Boaventura[1], Lucas Cardoso Laurindo[2], Cristiane Macedo del Rio do Valle[3], Rodrigo del Rio do Valle[3,4], Claudia Carvalho do Nascimento[5], Juliana Plácido Guimarães[1], Carolina Pacheco Bertozzi[6]

1 Instituto Biopesca, Praia Grande, SP, Brazil • JCC: juarezecocabral@gmail.com https://orcid.org/0009-0001-5363-9057 • VLR: vlanesvet@gmail.com https://orcid.org/0000-0001-8142-9295 • GCS: gabrielacristina.dharma@gmail.com • ICRB: isabella-boaventura@yahoo.com.br https://orcid.org/0000-0002-3499-4598 • JPG: juliana.guimaraes@biopesca.org.br https://orcid.org/0000-0002-6511-8718

2 Cooperative Institute for Marine and Atmospheric Studies, University of Miami, Miami, FL, USA • LCL: llaurindo@earth.miami.edu https://orcid.org/0000-0002-2906-8397

3 Instituto de Estudos e Conservação do Meio Ambiente (ECOEMA), Peruíbe, SP, Brazil • CMRV: cristianemvalle@gmail.com

4 Instituto de Ciências da Saúde, Universidade Paulista, São Paulo, SP, Brazil • RRV: rdrvalle@gmail.com https://orcid.org/0000-0001-6570-4138

5 Mineral Engenharia e Meio Ambiente, São Paulo, SP, Brazil • CCN: cnascimento@mineral.eng.br https://orcid.org/0000-0001-9247-5000

6 Laboratório de Biologia e Conservação de Organismos Pelágicos, Instituto de Biociências, Universidade Estadual Paulista "Julio de Mesquita Filho" (UNESP), São Vicente, SP, Brazil • CPB: carolina.bertozzi@unesp.br https://orcid.org/0000-0002-7175-1755

* Corresponding author

Abstract. Sooty Tern, *Onychoprion fuscatus* (Linnaeus 1766), is a rare species along the Brazilian coast due to oceanic habits. We report the first documented record of this species from São Paulo state, southeastern Brazil. The specimen was found beached in Mongaguá municipality. Morphological assessment, necropsy, and histological analysis allowed us to identify species, reproductive state (non-breeding), and sex (male) of this specimen.

Keywords. Atlantic Ocean, Charrán Sombrío, distribution range, São Paulo coast, southeast Brazil, *Sterna fuscata*, trinta-réis-das-rocas

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Introduction

Onychoprion fuscatus (Linnaeus 1766), also known as Sooty Tern, belongs to the tern group, which, along with gulls and skimmers, compose the family Laridae (Bridge et al. 2005; Gill et al. 2023). Compared to gulls, terns generally have a smaller, more slender body; a longer beak relative to the head; narrow, pointed, smaller feet (Winkler et al. 2020); and a shorter neck, which increases the horizontal projection of the bill–tail axis. Terns also often differ from gulls in their elongated, forked outer tail feathers.

Terns are typically described as coastal seabirds (Cabot and Nisbet 2013); however, *O. fuscatus* is predominantly pelagic and exhibits the broadest distribution among its congeners (Schreiber et al. 2020). Its usual breeding areas are on isolated islands with little human impact, and these are concentrated in all tropical oceans, most of which are between latitudes 30 °N and 30 °S (Schreiber et al. 2020). In the Atlantic Ocean, *O. fuscatus* breeds on various islands in the Caribbean Sea and Gulf of Mexico, islets in deltas of Senegal, Selvagens Islands near Morocco, Príncipe Island in the Gulf of Guinea, French Guiana (Schreiber et al. 2020),

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St. Helena Island (Beard et al. 2013), Ascension Island (Hughes et al. 2017), and in Brazilian territory, on the Fernando de Noronha Archipelago, Trindade and Martin Vaz, Abrolhos, and Atol das Rocas (Mancini et al. 2016; Somenzari et al. 2018).

Despite being the most abundant seabird in tropical oceans and its Red List status of Least Concern (IUCN 2023), Hughes et al. (2017) showed that the largest breeding colony in the Atlantic, on Ascension Island, has declined by approximately 84% in three generations and, according to the IUCN criteria, may be regionally Critically Endangered.

This species is one of the most aerial birds, spending long periods in flight, most of the time from its first flight, at two months of age, until its first breeding attempt at five or more years old. Between reproductive periods, these birds return to the aerial environment (Schreiber et al. 2020).

It is rare to find *O. fuscatus* on the Brazilian coast, possibly due to its preference for predominantly oceanic habitats (eBird 2023; GBIF 2023; SiBBr 2023; Wikiaves 2023). This species' distribution extends from the extreme north of Brazil to the latitude of Rio de Janeiro in the Southeast Region of the country (Birdlife International 2020). Here, we document the first known occurrence of an individual of *O. fuscatus* from the state of São Paulo, southeastern Brazil.

Methods

This record was obtained during the Projeto de Monitoramento de Praias da Bacia de Santos (PMP-BS), which is part of the federal environmental licensing process conducted by the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA). The project covers just over 1,500 km of Brazil's southeast and southern sandy shoreline. The project's aims are to assess the interference of oil and natural gas exploration and production activities in the Santos Basin. Since 20 August 2015, the monitoring has been carried out daily and regularly by technicians who record stranded marine animals, collect carcasses for necropsy, and rescue debilitated live animals for veterinary care, rehabilitation, and return to nature (license MMA/IBAMA ABIO no. 1169/2019).

In the care centre, individual of *Onychoprion fuscatus*, which was found alive, underwent a clinical evaluation and had its body mass measured on an electronic scale (Micheletti model P-15; error = 5 g). After death, a necropsy was conducted on the fresh carcass, and biometry was performed to aid in identification using calipers with a precision of 0.1 mm to measure the head length (HL), bill height at the base (BHB), bill height at the minimum nares (BHMN), bill height at gonys (BHG), bill width at the base (BWB), bill length (BL), nostril-to-tip of bill length (NTBL), tarsus length (TsL), tarsus diameter (TD), hindlimb length (HliL), middle toe with nail length (MTNL), and middle toe without nail length (MTNWL); a ruler with a precision of 1 mm was used for total length (TL), flattened wing chord (FWC), wingspan (WS), wing width (WW), and tail length (TailL).

Identification to species, sex determination, and developmental stage were performed through plumage characteristics, as well as macroscopic and histological analysis of the gonads. After the necropsy, the carcass was deposited at the Instituto Biopesca collection as a voucher.

Previous occurrence data of the species in the São Paulo state area were obtained and verified in two stages. The first stage was conducted using the PMP-BS database, the Sistema de Monitoramento da Biota Aquática (SIMBA), where all *O. fuscatus* recorded were counted. The second stage, following the protocol suggested by Carlos et al. (2010), consisted of an extensive bibliographic and museological survey to search for evidence or indications of the occurrence of this species. The protonym "*Sterna fuscata*" and the junior synonym "*Sterna fuliginosa*" were also used as search terms for this species.

Results

New record. BRAZIL – São Paulo state • municipality of Mongaguá; 24°07′48.7″S, 046°41′10.5″W; 1 m alt.; 07.I.2022; Gabriela Cristina da Silva (Instituto Biopesca) leg.; 14:03 h, sand beach, manual capture; cachectic, non-breeding adult, 1 ♂, IBP 10384.

The specimen was rescued for rehabilitation, medicated, and fed via an orogastric tube until its death occurred three days later.

Identification. The specimen was identified as *Onychoprion fuscatus*. It presented blackish upperparts (crown, nape, back, wings, and tail) contrasting with the white forehead and underparts, as described by Schreiber et al. (2020), which, with the absence of the bursa of Fabricius found during necropsy, also allowed us to identify the specimen as an adult individual. The underwing coverts were white contrasting with the darker primary and secondary feathers; the undertail coverts were white and the rectrices were whitish to grayish (Fig. 1). The webbed feet and bill were black. The biometric data are presented here: body mass on the day of rescue = 140 g, TL = 380 mm, WS = 734 mm, FWC = 267 mm, WW = 89 mm, TailL = 148 mm, HL = 87.7 mm, BL = 42.7 mm, BWB = 15.7 mm, BHB = 10 mm, BHNM = 7.6 mm, BHG = 7.4 mm, NTBL = 31.5 mm, TsL = 24.1 mm, TD = 3.6 mm, HliL = 27.1 mm, MTNL = 26.6 mm, MTNWL = 20 mm. The measurements are compatible with those described in the literature for this species (Schulz-Neto 1998).

The sex was determined as male by the observation of the male gonads during necropsy (Fig. 1D) and the absence of elongate, white outermost tail feathers, which indicate a non-breeding phase. The non-breeding state was subsequently confirmed in the histological analysis of the gonads. Small seminiferous tubules were observed in the medullary region with moderate

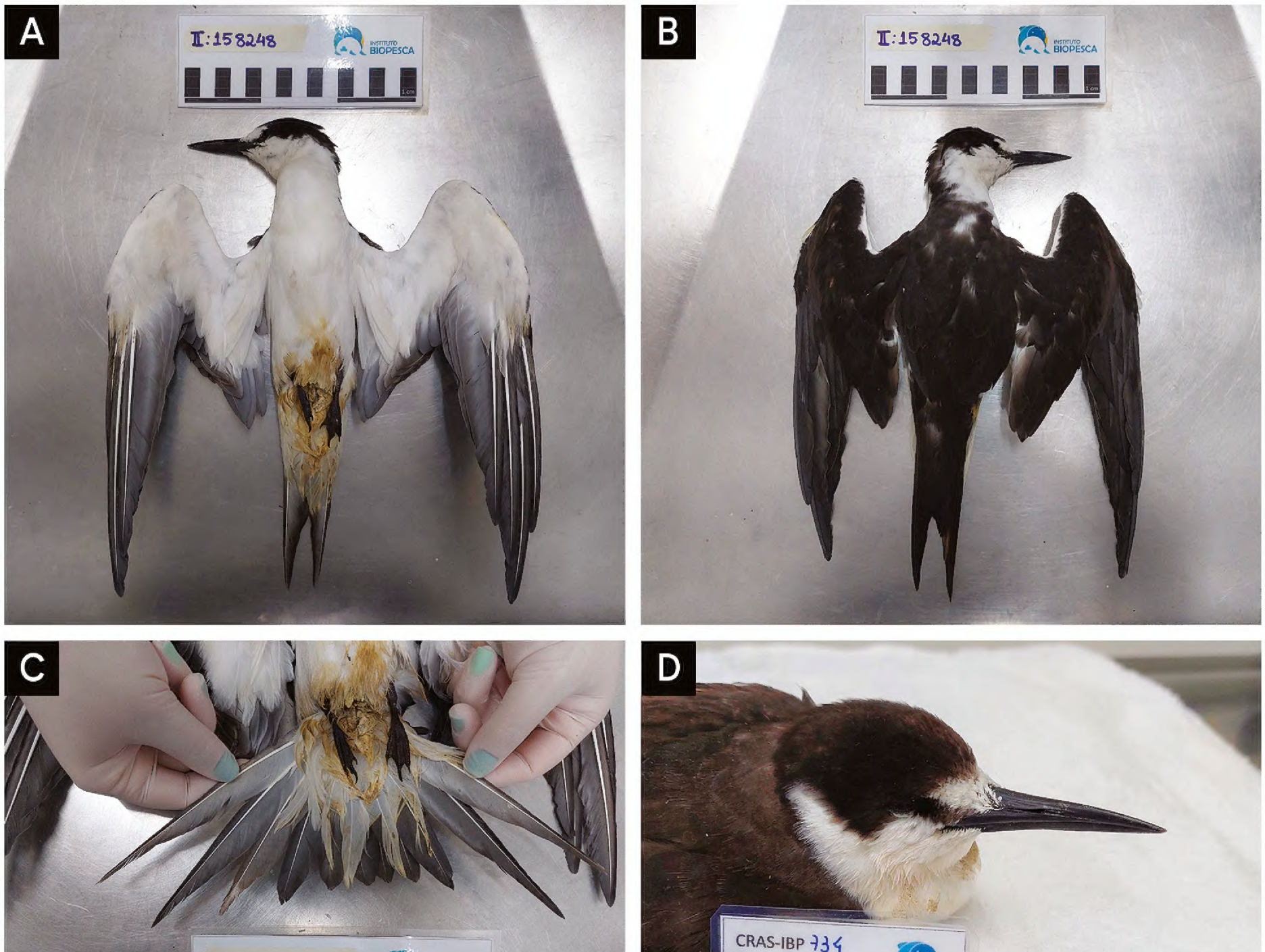

Figure 1. Sooty Tern (*Onychoprion fuscatus*). **A.** Ventral view. **B.** Dorsal view. **C.** Tail feathers showing absence of outer pairs characterizing a non-breeding phase. **D.** Live individual with a white forehead patch extending without passing the eyes. **E.** Right (RG) and Left (LG) Male Gonads. **F.** Histological section of the gonad shows seminiferous tubules (ST) with a few spermatogonia (Sp) and the absence of spermatozoa in the lumen (Lu), indicating the non-breeding phase (10×, Hematoxylin and Eosin staining).

interstitial tissue and small or absent lumens. The tunica albuginea was thin and detached from the tubules. Sertoli cells and a few spermatogonia were observed in the lumen of the seminiferous tubules, along with degenerating cells and the absence of spermatozoa (Fig. 1F).

Onychoprion anaethetus (Scopoli 1786), a species not recorded in Brazilian territory but present in the Atlantic Ocean, has a white forehead patch which extends to the posterior eye region, while in *O. fuscatus* this patch extends only to the area above the eyes. Additionally, the blackened dorsal region in our specimen was continuous through the nape to the crown, whereas *O. anaethetus* has a more grayish-brown back with white at the base of the nape. *Onychoprion fuscatus* differs from *Puffinus puffinus* (Brünnich, 1764) mainly by the absence of the nasal tube, which is characteristic of the Procellariiformes.

Discussion

We unequivocally identified our specimen as *Onychoprion fuscatus* based on its plumage. The morphometry of this specimen is similar to the measurements taken by Schulz-Neto (1998) for individuals from Atol das Rocas, except for FWC, NTBL, and weight. The latter is probably much lower due to the animal's poor condition, and FWC is smaller because the P10 feather was in a growth phase and even smaller than P09.

The movements of *O. fuscatus* are still poorly understood (Soanes et al. 2015). Although this species is considered a resident of Brazil due to its regular reproduction on oceanic islands (Pacheco et al. 2021), it can be considered a vagrant on the continent due to sporadic records. The Atlantic reproductive colonies are on islands in the Caribbean and Gulf of Mexico, islands of French Guiana, the archipelagos of Fernando de Noronha, Atol das Rocas, Abrolhos, Trindade and Martin Vaz, and Ascension, as well as islands off the coast of Africa (Schreiber et al. 2020). Due to the closer proximity of the Brazil's North and Northeast regions to the reproductive colonies than Southeast and South regions, continental records are slightly more frequent than those in other areas of Brazil: North Region: Amapá (Grantsau 2010) and Pará (Sick et al. 1997); Northeast Region: Maranhão (Sick et al. 1997; Gonsioroski 2015), Ceará (Rocha 1948), Paraíba (Mestre et al. 2010), Pernambuco (Olmos 2002), Sergipe (PMP-SE/AL: ii 205836 in SIMBA 2023) and Bahia (Lima 2006; MZUSP: 102314, 102331, 102734 in SIBBr 2023); PMP-SE/AL: ii 206030 in SIMBA 2023); Southeast Region: Espírito Santo (MBML_ZOO_AVES: 7499 in GBIF 2023; PMP-BC/ES: ii 138476 in SIMBA 2023) and Rio de Janeiro (MZUSP: 80803 in GBIF 2023); South Region: Paraná (PMP-SC/PR: ii 191466 in SIMBA 2023). There have been no prior records of this species in São Paulo state, southeastern Brazil.

In its pelagic habitat, *O. fuscatus* forages by flying at less than 20 m over the water surface, capturing mainly fish and squid in shallow water less than 10 cm deep; however, flying fish can be caught in midair (Schreiber et al. 2020). Tropical oceanic waters have lower productivity than temperate and polar waters, resulting in a distinct trophic chain with more unpredictable food resources for seabirds exploiting this habitat (Weimerskirch 2007). Seabirds, and especially *O. fuscatus*, disperse in the Atlantic Ocean, possibly adopting a search strategy for habitat patches with greater availability of prey. The southwestern Atlantic is influenced by the Cabo Frio upwelling system which increases its productivity (Odebrecht and Castello 2001; Valentin 2001; Lutz et al. 2018; Calil et al. 2021), making it richer and more predictable in food resources for marine birds (Weimerlkirch 2007). Successive annual increases in the oceans' water temperature, particularly in the Atlantic, have been recently reported, and all-time heat records broken in 2020 and 2021 (Cheng et al. 2022). In their study on the movements of *O. fuscatus* at Ascension Island, Reynolds et al. (2021) suggested that in years with higher sea-surface temperatures, birds tended to disperse further in search of resources; such a response to warming seas may have contributed to the new record from the state of São Paulo.

Many oceanic seabirds, when weakened, tend to strand on beaches after storms at sea, as prevailing winds push these animals toward the coast (Newton et al. 2009; Tavares et al. 2016). At the time the *O. fuscatus* specimen was rescued, eastward wind speeds of 1–5 km/h were recorded at the site. At a larger geographic scale (Fig. 2), the passage of a cold front was observed in the state of São Paulo on January 6–7, 2022; this front had a southeast to northeast direction, which is associated with the South Atlantic Subtropical Anticyclone, and had opposing warm winds. These winds may have contributed to the specimen's displacement toward the cold front, where there is a high probability of storms. After this front's passage, prevailing southeast winds are toward the Brazilian coast.

Based on our investigation, we consider the stranded individual of *O. fuscatus* to represent the first record of this species from the state of São Paulo. It was a cachectic adult male in non-breeding phase.

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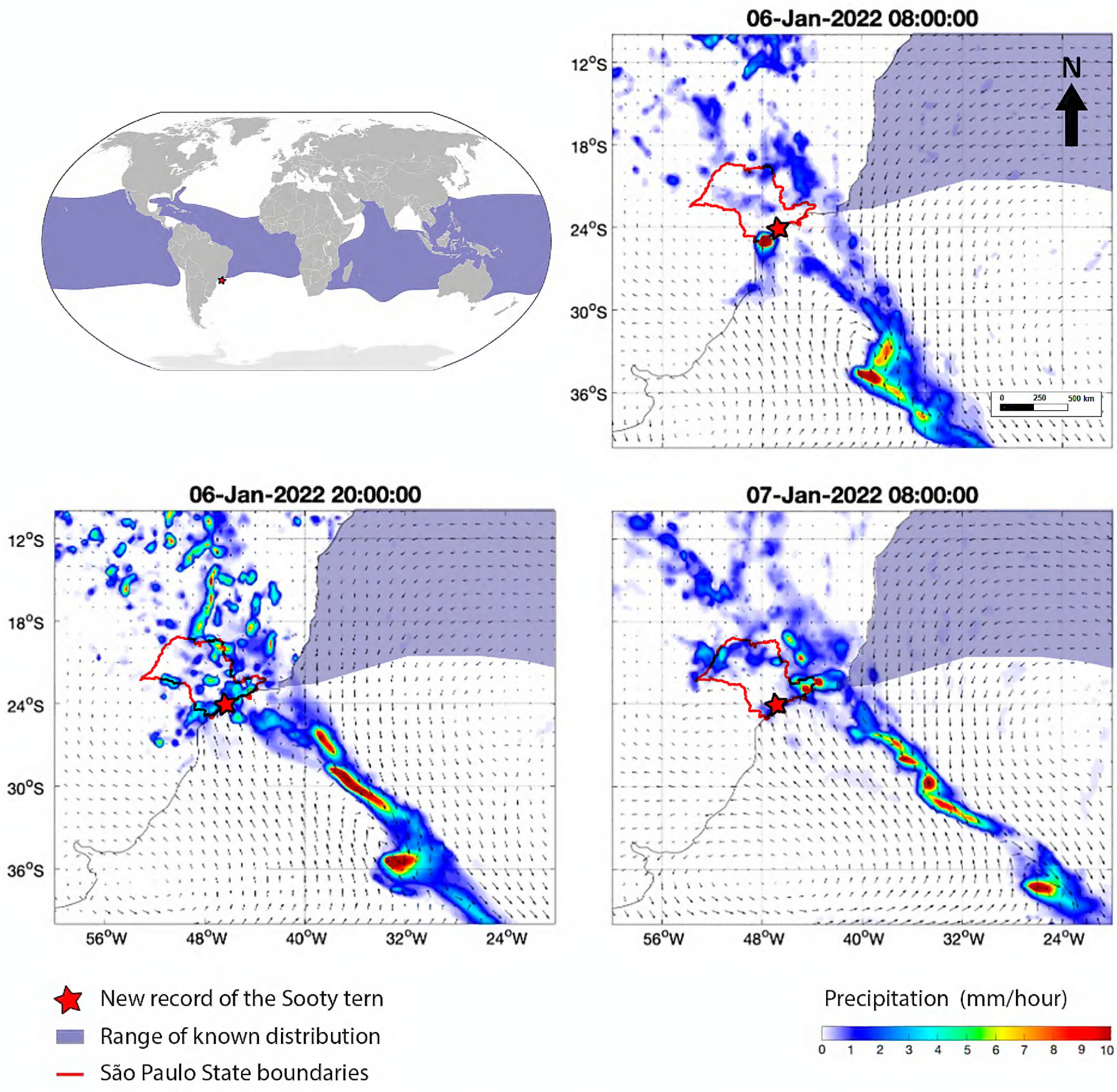

Figure 2. Global distribution of the *O. fuscatus* (Birdlife International 2023) and precipitation records (color-filled area) at three different times in the 12 h before the *specimen* was found, indicating the movement of a cold front from the southwest to the northeast. The vectors indicate the direction of the winds. The precipitation and wind map was constructed using data analysis from the ERA5 reanalysis model (Hersback et al. 2018).

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Author Contributions

Conceptualization: JCC, RRV, CPB. Data curation: JCC, VLR, RRV, CCN, JPG. Funding acquisition: CCN, CPB. Investigation: JCC, VLR, GCS, ICRB, LCL, CMRV. Methodology: JCC. Resources: RRV, CCN, JPG, CPB. Supervision: CPB. Writing – original draft: JCC, VLR, CMRV, RRV. Writing – review and editing: JCC, VLR, GCS, ICRB, LCL, CMRV, RRV, CCN, JPG, CPB.

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